

The knowledge about using Finnish sauna in post-event recovery among judokas

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Key words: Finnish sauna, judo, thermoregulation, dehydration, hormones, biological regeneration

Summary

Introduction. Sauna bathing is a good method of eliminating mental and physical fatigue relatively quickly as it favorably affects the entire human body. Sauna is recommended not only for relaxation and resting after physical work, but also after injuries of the musculoskeletal system, therefore it is often suggested to athletes as one of the forms of biological regeneration. The aim of this study was to test the knowledge and awareness of judo practitioners concerning the physiological effects of sauna and to compare their knowledge of this issue with the knowledge of their non-training counterparts.

Material and methods. 40 male judo practitioners and 40 non-training males participated in the study. In both groups the mean age was 22±4 years. A questionnaire containing questions based on the available literature was used for the study. The questions concerned physiological effects of sauna on all body functions, the ways of using sauna and the duration of sessions.

Results. All the surveyed athletes admitted they used sauna as a form of biological regeneration. Among the non-training males 25 respondents reported using sauna. 37 judo practitioners know that sauna bathing is a form of biological regeneration. Among the non-training males only 18 are aware of that fact.

Conclusions. The obtained results indicate that the surveyed athletes try to extend their knowledge of sauna bathing as a form of biological regeneration. Their knowledge of this issue is better than the knowledge of their non-training counterparts. There is also a necessity to disseminate the knowledge and educate the non-training individuals about using sauna and learning about body responses to warm and cold stimuli.

Introduction

Finnish (dry) sauna is one of the most popular methods of biological regeneration. This is a physical procedure used also for hygienic purposes, such as body care and for medical purposes, e.g. body strengthening. A regular use of sauna affects the body in many ways. Thermal treatment in sauna is one of the so called biomedical approaches of biological regeneration, broadly applied, both in motor recreation and competitive sports [1-4].

The idea of sauna, originating from Finland has been used in many parts of the world. Apart from Scandinavian saunas, the first saunas were built in Pennsylvania in 1638. In Europe, the first saunas were built as late as in 1936 on occasion of the Olympic Games in Berlin. Finnish saunas have become popular thanks to the popularization of the social movement which contributed to their development, initially for recreation and next, they became the components of Finnish houses.

For Finnish people, sauna is still the basic hygienic and relaxing procedure, affecting the entire human organism [5].

The thermoregulatory mechanism, activated during the "sweat bath" generates a series of responses in the nervous, cardiovascular, endocrine and respiratory systems and causes hormonal, metabolic and electrolyte changes [6].

"Sweat bath" quickly eliminates mental and physical fatigue as it favorably affects the entire body. During a series of procedures, the body is detoxified, because toxins are removed with sweat. After being intensely heated, the body is cooled and during this process blood oxygen level increases and the mind is relaxed. For this reason, sauna is recommended not only for relaxation and rest after physical work, but also in cases of post-injury conditions of the musculoskeletal system; therefore it is often recommended to athletes as a form of biological regeneration [7].

Unfortunately, there are more and more cases of improper use of the sauna, both among athletes and in non-training

individuals. Athletes often use this form of biological regeneration immediately after intense physical exercise when the body is dehydrated or before the start of competitions. Such errors are made mainly by the competitors practicing the disciplines involving the division into weight categories. They use the sauna to reduce their body mass, making their bodies extremely dehydrated [8-11]. Improper use of the sauna as well as improper methodology of using this form of recreation made the authors check the knowledge of this issue among athletes and non-training individuals.

The goal of this study was to check the knowledge and the awareness of the effects of sauna among judo practitioners and the comparison of their knowledge with that of their non-training counterparts.

Material and methods

40 male judo practitioners, training from 4 to 8 years and 40 non-training male students participated in the study. In both groups the mean age of the subjects was 22±4 years. The study used a survey containing questions based on the available literature. The questions concerned physiological effects of sauna on all body functions, the ways of using it and the duration of sessions.

Results

All the surveyed athletes reported using a sauna as a form of biological regeneration. 25 non-training participants admitted they used a sauna (Table 1). 37 judo practitioners turned out to have a good knowledge of sauna as a form of biological regeneration (Table 1). Among the non-training respondents only 18 (Table 1) turned out to have equal knowledge of this issue (Table 1). 38 competitors admitted their knowledge came from their trainer, who is the closest source and agreed with all his/her guidelines to improve their health state and body fitness; only 2 participants read information about sauna on the Internet. 30 judo practitioners and 20 non-training subjects reported using a sauna once a week. 10 judo practitioners and 12 non-training subjects reported using a sauna twice a week. Only 8 non-training subjects reported using sauna

hardly ever. The surveyed judo practitioners have been using a sauna for 3 years on average while their non training counterparts have been using it for 1.5 years on average. All the surveyed athletes know how to use a sauna, and how long the periods of heating and cooling should be. As for the non-training respondents, their knowledge of sauna usage is insufficient and only 14 subjects know the proper methodology of sauna usage. 24 athletes and 37 non-training subjects were unaware of the threat of body cooling. Most often they improperly cool their bodies which can be life-threatening. All training persons know that everybody should be naked in a sauna, however, 20 non training subjects think it is not important whether to enter a sauna naked or in underwear. 38 surveyed athletes know that sweating in a sauna is the only thermoregulatory way of eliminating excess heat from the body under such conditions. 19 non-training subjects are not aware of the fact that thermoregulatory processes lead to dehydration in sauna. 38 athletes are aware of the resistance improvement through repeated sessions in a sauna while in 25 non-training subjects the knowledge of this issue is insufficient. 30 surveyed athletes and 38 non-training subjects know nothing about increased ventilation of the lungs during sessions in a sauna.

Discussion

Sauna bathing is one of the elements of biological regeneration for athletes, therefore saunas are so often used by this population. However, the knowledge of this form of treatment is insufficient, both among training and non-training persons [12]. In the presented study, the surveyed athletes report using this form of biological regeneration, but not everybody is aware enough of the physiological processes involved during hot and cold bathing. A high proportion of the surveyed population are unaware of the fact that exposure to high temperatures in the steam room is possible thanks to multiple physiological processes occurring in the body. In a hot room, the human body gets rid of the heat resulting from metabolism and the heat acquired from the environment, only during a certain period of time. After several minutes of bathing in sauna body temperature quickly increases. Skin temperature increases more quickly than the core body temperature. Already

Table 1. The knowledge on the effects of sauna on the human body among the study subjects

	Non-training males		Judo practitioners	
	yes	no	yes	no
Do you use a sauna as one of the forms of biological regeneration?	25	15	40	0
Do you have any knowledge of sauna usage as a form of biological regeneration?	18	22	37	3
Do you know that sauna improves coronary circulation and stabilizes arterial blood pressure?	21	19	31	9
Do you know that sessions in sauna result in body mass reduction through dehydration?	31	9	37	3
Do you know that sauna bathing cleanses the body from toxins (metabolic waste products)?	31	9	40	0
Do you know that sauna bathing results in the decrease in physical fitness, strength and power, which maintains even 24 hours?	10	30	34	6
Do you know that sauna bathing improves body resistance to diseases?	18	22	31	9
Do you know that sauna should not be used after intense physical exercise resulting in dehydration and elevated body temperature?	15	25	25	15

after 4 minutes of sauna bathing skin temperature reaches about 40-41°C. Further exposure to elevated temperature causes heat concentration in the body and an increase in body core temperature. During a 20-minute sauna bathing, core body temperature can increase even by 4°C [6], however, it does not reach 40°C [13,14].

Overheating activates the thermoregulatory mechanism under such conditions – this is obtained through sweating and evaporation of the water from skin surface. Increased perspiration starts after the first 3 minutes of sauna bathing, but the highest values of perspiration are reached after 10 minutes [15]. Among the respondents, most of the judo practitioners know that perspiration is the only way of eliminating excessive heat from the body and leads to dehydration. The survey results show that the non-training respondents are not aware of dehydration associated with perspiration during sauna bathing.

In exposure to high temperature about 60% of sweat evaporates while the remaining amount streams down as drops, having no thermoregulatory effect. The mean sweat production is about 20g/minute and during the entire session it can reach the values from 400 to 600g [16]. Water loss and sweating results in transient loss of body mass due to dehydration. With sweat, sodium, potassium, chloride, magnesium, calcium, copper and zinc ions are released [6]. Most of the non-training respondents are not aware that toxic substances are also released with sweat through the skin which results in skin purification.

The observed excessive increase in glucose levels in sauna bathing in children which is not modified or moderate elevation of glucose levels in adults result from hormonal stimulation [17]. The authors think that elevated glucose levels can result from the increased secretion of catecholamines or prolactin which inhibits insulin secretion [17].

Due to overheating during sweat bathing, excessive loss of body fluids occurs; initially extracellular and next, intracellular fluids are shifted which is manifested by reduction of plasma levels and intracellular space. Modification of plasma volume causes a decrease in the circulating blood which results in the increase in erythrocyte count, hematocrit level and haemoglobin concentration in volume unit [18]. It has also been noted that neutrophil granulocyte count and eosinophil granulocyte count increase. The decrease in lymphocyte count can be explained by the intensified activity of cortico-adrenal hormones [19]. Therefore we can conclude that sauna bathing does not contribute to the risk of thrombosis or a tendency to haemorrhages, which is the result of securing the course of homeostasis during and after sweat bathing. Finnish sauna bathing activates endocrine glands and stimulates the immune system [20, 21]. It is documented that hot-cold bathing decreases susceptibility to common cold and prevents infections in healthy people [15, 22, 23]. Not all the respondents are aware of the improvement of resistance during repeated sauna bathing, but they have used this form of biological regeneration twice a week, on average for 3 years. The non-training subjects, in turn, have not enough knowledge of this issue.

Sauna bathing evokes a series of endocrine changes in the body which are the so called emergency responses, espe-

cially intense in individuals who are not adapted to sauna. The common response to various factors that release stress including thermal stress involves activation of the hypothalamus-pituitary-adrenal system (hypothalamic-pituitary-adrenal axis) and the sympathoadrenergic system (hypothalamic-sympatho-adrenal axis), resulting in increased adrenal hormone secretion and changes related to the function of these hormones [20]. The increase in blood cortisone level or cortisone or cortisone metabolite and catecholamine urine excretion is regarded as the exponent of thermal body load and the response to that load [24]. Intensified ACTH secretion in exposure to thermal stress is associated with increased secretion of beta-endorphin, one of the endogenous opiate peptides participating in thermoregulation at the level of the Central Nervous System (CNS) or at the periphery [20]. The target organ of ACTH is a band and mesh layer of the adrenal cortex where glucocorticoids are synthesized; cortisone is the most important glucocorticoid. Growth hormone is another hormone whose secretion increases due to thermal stress. Growth hormone (hGH) affects protein, carbohydrate and fat metabolism. It has an anabolic effect on protein metabolism and a catabolic effect on fat metabolism; it stimulates lipolysis releasing free fatty acids to the blood and increasing its oxidation which leads to a decrease in the respiratory ratio [24]. Changes in fat metabolism lead to a decrease of LDL cholesterol fraction in the plasma, which was noted by Pilch et al. in their studies in young female subjects after 14 sessions of sauna bathing [25]. Decreased levels of sodium in the body during and after thermal exposure in sauna can be the factor responsible for increased prolactin secretion [20, 26].

Increased metabolism during sauna bathing is stimulated by the increase in core body temperature and hormonal changes, leading to the decrease in blood pH and carbohydrate level and elevated arterial blood pressure. Such a condition can be due to blood flow redistribution or body dehydration. The decrease of pCO₂, H⁺ ion concentration improves the function of the respiratory center and modifications in the opposite direction have an inhibitory effect. Modifications in blood chemical composition affecting pulmonary ventilation are due to respiratory chemoreceptors in aortic and cervical glomera and the neurons in the medulla oblongata. Respiratory minute ventilation is in an adequate proportion to the amount of metabolic modifications in the human body and CO₂ is the mediator between them. The response to the changes in blood chemical composition involves increased minute ventilation, respiratory rate, lung volume and the intensity of the respiratory volume. All these modifications are not significant and do not exceed 10% according to Scandinavian researchers or are higher according to other researchers [27, 28]. The surveyed athletes as well as their non-training counterparts have poor knowledge of increased pulmonary ventilation during sauna bathing.

With the increase in skin temperature and stimulation of the adrenergic system the circulatory system is activated as well. Loading of the cardiovascular system is characterized by increased cardiac output and heart rate (HR) increasing

linearly with temperature growth. It also depends on humidity and changes, according to Kukkonen Hajrjuli, by 60% on average for the temperatures of 80°C and 90% and by 130% for the temperature of 80°C in the environment where relative humidity is above 30% [13]. Increased pulse rate with simultaneous vasodilatation causes the increase in HR, even by 400% of the resting value, namely by about 6.6 l [29]. Cardiac output increase is not due to the increase in stroke volume. The modifications due to dilatation of the precapillary vessels in the arterial and venous parts and in the skin result in decreased peripheral resistance. In consequence, circulation in the skeletal muscles and in the skin improves. In exposure to increased thermal stress, dermal flow can increase even to 8 l/min or to 60% of cardiac output [2, 30].

During sauna bathing HR increases to 100-160 beats per minute (bpm) [26, 31]. This is due to activation of the sympathetic nervous system, the activity of noradrenalin which is secreted in greater amounts in exposure to thermal stress and the temperature of blood flowing to brain circulation centers increases [19]. In the reported study, the surveyed athletes turned out to be aware of HR increase during sauna bathing, unlike their on-training counterparts who know nothing about it. It is generally believed that it moderately increases [32], although there are reports about its decrease due to overheating, especially during long sessions in sauna [18]. Diastolic blood pressure usually decreases in such conditions [29]. Diastolic pressure usually decreases. A significant increase in arterial blood pressure is also noted when water is poured on stones and with a sudden increase in humidity in sauna, and due to body cooling procedures (from 150/85 mmHg to 250 mmHg) [29]. Cold shower, swimming in cold water or rolling in the snow after leaving the hot room result in a sudden constriction of dermal blood vessels and the increase in arterial blood pressure [6]. Persons with hypertension should resign from sudden body cooling. Loading of the circulatory system during hot bath can be compared to exercise load when performing light physical work. The surveyed subjects are not aware of the threat connected with sudden cooling of the body. Most often they do it improperly, risking their health.

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Sauna bathing causes a substantial decrease in physical fitness. Even after quick compensation of water after taking sauna, muscle strength and physical fitness are decreased within about 24 hours. The loss of about 2-2.3 kg of body mass requires drinking about 2.5-2.8 liters of liquids, which should compensate the water and electrolyte deficits, usually within several hours [26]. Body dehydration results in a series of adverse changes including: decrease in plasma volume, cardiac minute output, HR acceleration and decrease in dermal and muscle blood flow. In consequence, these changes can lead to decreased ability to long-term submaximal exertion, which has been noted in multiple experiments carried out both in trained and untrained individuals [2, 3]. Body fluid loss resulting in body mass decrease by 4-5% is believed to decrease physical fitness by 20-30% [2, 33, 34]. The surveyed athletes are not aware about the decrease in body fitness due to sauna bathing, therefore some of them reported taking sauna immediately after physical exercise which can adversely affect their health.

Conclusions

1. The results obtained from the survey indicate that the subjects tend to extend their knowledge of sauna usage as a form of biological regeneration. Their current knowledge is better than the knowledge of their non-training counterparts which indicates that sauna bathing has become popular as one of the elements of biological regeneration. Nevertheless, their knowledge of this issue should be extended.
2. It is necessary to disseminate knowledge and educate non-training persons about the effect of taking sauna and to learn body responses to hot and cold stimuli. This aspect is especially important due to the growing number of biological regeneration or SPA centers where sauna is widely used and an improper methodology of taking sauna can compromise body regeneration.

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